Snow strength depends in a complicated way on the snow density, crystal structure, and temperature. For this reason, it varies greatly within a snow pack.

When a slab avalanche is released, a thick layer of snow slides along the surface of stationary snow, in a process known as shear. Ronald I. Perla and David M. McClung at Environment Canada in Canmore, Alberta, are studying the behavior of snow in shear. McClung has observed that snow becomes easier to fracture or deform after it has been deformed a little. This property may help explain why avalanches are precipitated suddenly, sometimes without apparent stimulus. By deforming slowly, the weak layer becomes weaker. When it becomes too weak to support the overlying snow, fracture occurs, and the released slab accelerates down the mountainside.

In the past few years, investigators have been able to make measurements on avalanches in motion. This has added another dimension to the characterization of snowslides since prior data came only from after-the-event studies of avalanche paths and destruction.

Peter Schaerer at the National Research Council, Division of Building Research in Vancouver, Canada, has monitored some known slide paths in order to measure avalanche velocities and impact pressures. These features are of interest to structural engineers designing buildings and bridges for mountainous areas. Average, moderate-sized avalanches travel about 30 meters per second, observes Schaerer; but he has measured speeds as high as 60 and as low as 10 meters per second. Investigators in France, Japan, and the U.S.S.R. also measure velocities in this range. However, researchers admit that huge avalanches, such as the earthquake-triggered one that buried the town of Yungay, Peru, in 1970, may travel much faster.

Continuous records of avalanche impact pressure reveal sizable fluctuations several times a second as the snow streams past the sensor. Although some investigators attribute the pressure peaks to collisions of individual snow particles with the transducer, others are skeptical. However, there are not enough data to resolve a major controversy on the nature of avalanche flow. The question is what happens to a slab of snow after it breaks loose and begins to move down a slope. Does it retain enough coherence to have a dense "core" region? Or, as some researchers suspect, does the slide rapidly become a low-density, fully turbulent flow—a snow cloud?

A definitive answer could be obtained by recording simultaneously the impact pressure at several heights above the stationary snow surface and at several locations across the path. Such a recording has yet to be accomplished because field measurements of natural avalanche dynamics are inherently difficult to make. Instrumentation must be installed in an avalanche track and remain functional and exposed until a slide occurs.

Numerical and experimental modeling is being performed by some groups. However, only the dynamics of the slide can be simulated with any confidence since details of the release mechanism are poorly understood.

Theodore E. Lang and his associates at Montana State University report that they can produce runout distances and average impact forces that are similar to those observed by field workers. Lang's computer routine is a modification of a program developed at Los Alamos Scientific Laboratory for modeling the transient shock phenomena associated with atomic blasts. Lang treats the avalanche as a laminarly flowing fluid, with the important physical parameters being fluid viscosity and frictional drag at the base of the flow. Lang's model is criticized by those who believe that avalanche flow is entirely turbulent.

To test the numerical model and provide better data on avalanche dynamics, Lang's group has studied small-scale man-made avalanches. They have dug a small channel in a snow pack and poured snow into the chute to create a mini-avalanche that could be monitored thoroughly. Although only the velocity of an unrealistically slow snowslide (6 meters per second) has been achieved, the experimental results could be simulated successfully by the computer program.

Taken together, the computer simulations, statistical studies, and field measurements are beginning to provide new insights into the mechanisms of a long-standing winter hazard. However, much remains to be learned before specific avalanche prediction becomes a reality.

—BEVERLY KARPLUS HARTLINE

Update

Cancer and Estrogens

Late last year, criticism of the evidence linking the estrogen drugs used to treat menopausal symptoms to an increased risk of uterine cancer spurred the Food and Drug Administration to take another look at its policy regarding the use of the drugs (*Science*, 22 December 1978, p. 1270). That policy requires that the estrogens carry a label warning physicians that the agents are associated with an increased risk of the cancer and urging caution in their use. Now the agency has decided that no change in its policy is needed.

The criticism provoking the FDA review was advanced by Alvan Feinstein and Ralph Horwitz of Yale University Medical School. They maintain that the epidemiological studies on which the policy is based are all flawed by a bias in their design that favors the detection of uterine (endometrial) cancer in estrogen users but not in nonusers. The FDA disagrees.

One of the factors in the agency decision was the publication of the results of another study, the largest performed thus far, indicating that the link between estrogens and endometrial cancer is both real and substantial.* The results agree with those of several earlier studies in which estrogen users were found to have a risk of endometrial cancer several times greater than that of nonusers. The current study also finds, as have some of the others, that the risk increases as both the dosage and duration of drug administration increase.

According to Feinstein, the new study suffers from the same flaw as the previous ones. In contrast, the study coordinator, Paul Stolley of the University of Pennsylvania School of Medicine, says that the study addressed—and refuted—the Feinstein-Horwitz criticism and also other criticisms leveled at the epidemiological evidence in the past. In particular, Stolley points out that no evidence was found in the new study that estrogen use speeds up the diagnosis of endometrial cancer. Feinstein counters that speed of diagnosis is not at issue. Rather, the issue is that the cancer is more likely to be detected in the users simply because use increases medical surveillance of the women and not because the drugs cause the cancer. It is safe to say that neither side in the controversy is much convinced by the arguments of the other. But the FDA is convinced. And there the matter rests.—J.L.M.

*C. M. F. Antunes, P. D. Stolley, N. B. Rosenshein, J. L. Davies, J. A. Tonascia, C. Brown, L. Burnett, A. Rutledge, M. Pokempner, R. Garcia, *N. Engl. J. Med.* **300**, 9 (1979).

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